16. Using Financial Analysis Techniques in Forestry Research

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Previous modules introduced the principles and methods of Discounted Cash Flow (DCF) and Cost Benefit Analysis (CBA) in relation to forestry projects. The current module extends the discussion of DCF to include its use in financial analyses. The purpose of CBA is to determine whether investment projects (used in the widest sense) are worthwhile from a social perspective, taking into account all costs and benefits including positive and negative externalities. In contrast, the focal point of financial analysis is assessing the impact of the project of the wealth of the individual or firm considering the project. In this module, concepts and methods of financial analysis (FA) will be introduced, and then applied to a case study of financial evaluation of a forestry project.

1. INTRODUCTION

Cost-benefit analysis (CBA) and financial analysis (FA) have many elements in common, the key distinction being that the former is carried out from the perspective of the society or community while the latter is carried out from the perspective of the private interests of the investor. CBA is typically used in making decisions about public sector projects. Financial analysis typically is used as a technique in the capital budgeting decisions of firms and individuals. CBA would include all the impacts (both financial and non-financial) of a project to the organization or government undertaking the project and to society as a whole. Financial analyses is more narrowly concerned about the financial or direct cash flow impact of a project to an individual or business, with environmental externalilties such as pollution only included in a financial analyses to the extent that they impose cash flows such as fines or clean-up costs on the firm or individual. Similarly, social benefits such as increased employment or standard of living by local communities from the establishment of a timber mill (relevant in CBA) would not be included in a financial analysis because there are no direct cash flow consequences to the firm.

In many ways financial analysis can be considered as a sub-set of CBA. The direct cashflow consequences of a project to the organization undertaking the project (as identified in a financial analysis) must be identified as part of a CBA, although the distinction is seldom explicitly drawn between cashflows directly impacting on the organization and those impacting on other parties affected by the project.

Capital budgeting is a multi-faceted activity. There are several sequential stages in the process. For typical investment proposals of a large corporation, the distinctive stages in the capital budgeting process are depicted, in the form of a highly simplified flow chart, in Figure 1. The evaluation is carried out within the strategic planning of the company, and the screening of investment alternatives. Information from the financial analysis is integrated with other information and objectives of the company to arrive at a decision to accept or reject each project. Accepted projects must undergo implementation and monitoring procedures.

2. SOME KEY CONCEPTS IN FINANCIAL ANALYSIS

Incremental cash flows

The concept of an *incremental cash flow* was introduced in the previous module. Incremental cash flows are the cash *inflows* and *outflows* which will arise from the implementation of a particular project, and are estimated by comparing the cash inflows and outflows of the firm '*with*' the project, and those '*without*' the project. It is a 'marginal' or 'incremental' analysis comparing two situations.

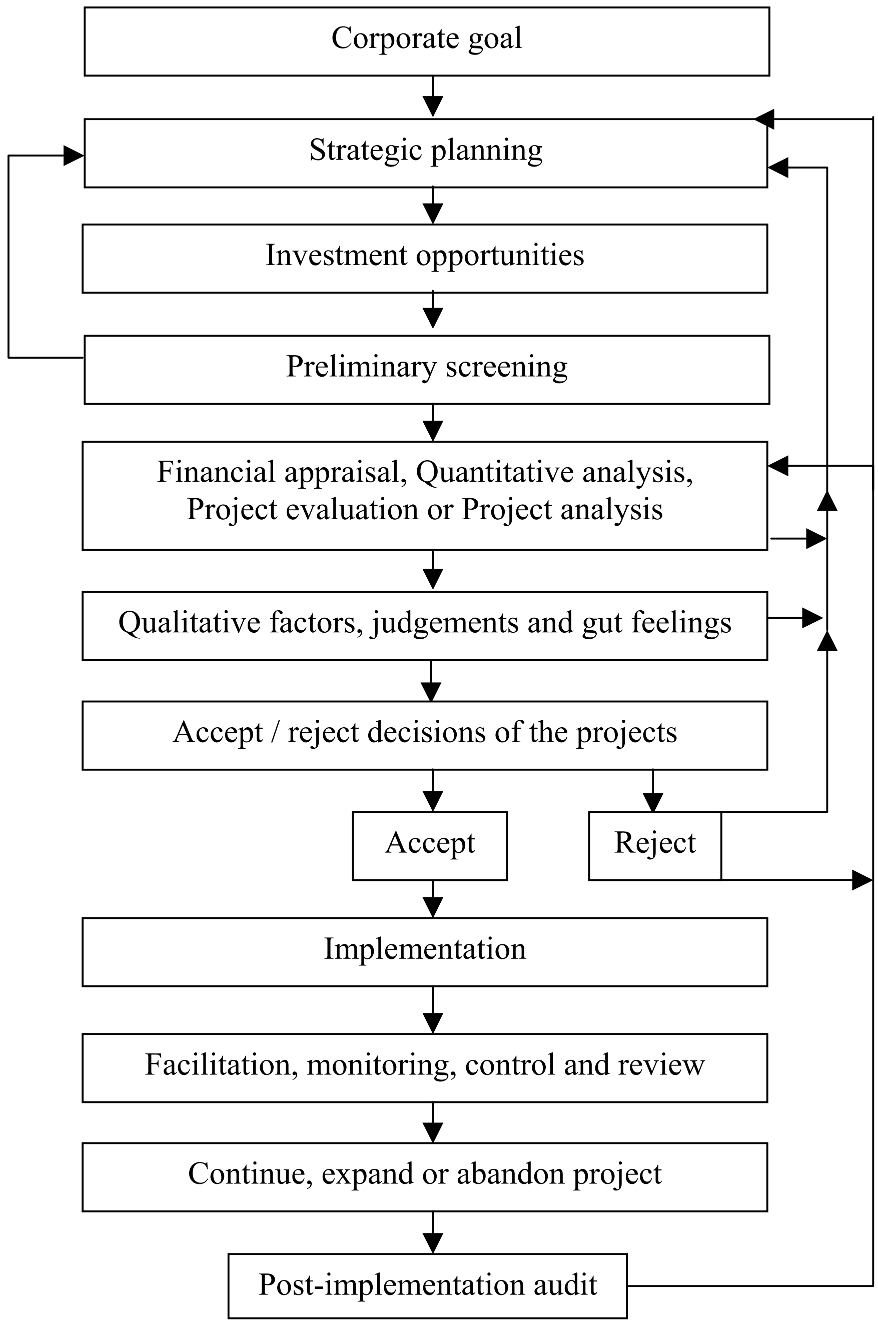

Figure 1. The capital budgeting process

For analytical purposes project cash flows may be separated into two categories: capital cash flows and operating cash flows. Capital cash flows may be disaggregated into three groups: (1) the initial investment, (2) additional 'middle-way' investments such as upgrades and increases in working capital investments, and (3) terminal flows. These are all cash flows and the distinction between them are only to facilitate the convenient identification of the different categories.

Synergistic effects and opportunity cost

All the indirect or synergistic effects of a project should be included in the cash flow calculation. Synergistic effects can be negative or positive. For example, suppose a land owner has 100 ha of plantations which are at a stage of requiring thinning. There is no current market for the thinnings and he will have to pay local people to thin his plantation. He is also considering buying a plant to make charcoal. If he buys the plant he could then use the thinnings from his plantations to make charcoal. In this case there is a positive 'synergistic effect' of investing in the charcoal plant i.e. the investment creates a use for a previous waste product.

The rationale for the incorporation of these indirect effects has its base in the 'opportunity cost' principle. When a firm undertakes a project, various resources will be used up and not available for other projects. The cost to the firm of not being able to use these resources for other projects is referred to as an 'opportunity cost'. The value of these resources should be measured in terms of their opportunity cost. The opportunity cost, in the context of capital budgeting, is the value of the most valuable alternative that is given up if the proposed investment project is undertaken. This opportunity cost should be included in the project's cash flows.

To consider another example, suppose a landholder is considering establishing 5 ha of Gmelina. The plantation will be established on land that he does not currently use but which he could rent out for 20,000 pesos per year. In this case the farmer will lose the opportunity to rent the land at 20,000 pesos per year if he establishes the plantation. This 'opportunity cost' should be included in the cash outflows of the project even though there has not been any actual cash payment. The reason is that opportunity cost of the space measures an extra cash flow that would be generated (for the firm) 'without' the project. On the other hand,suppose that the land has not been rented in the past and there is no intention to rent, sell or use for any other purpose in the future. In this case, there is no opportunity cost if the resource is used for the proposed project. Therefore, in this situation, the 20,000 pesos will not be included as a cash outflow.

3. TREATMENT OF KEY DCF VARIABLES

The basic principles of DCF analysis have been discussed previously. It is however useful to consider some of the key variables often found in DCF analysis in a little more detail.

Treatment of taxation payments

Tax is a cash payment to a government authority. How taxation payments are viewed differs depending on whether a CBA or FA is being undertaken. This is due to the different perspectives of each of these types of analysis. In CBA, in the perspective is that of the community, taxation payments are viewed simply as 'transfer payments' between one section of the community and another. They do not represent any net gain or loss to society, and hence are excluded from incremental cash flows.

With a financial analysis the focus is on the cashflow impacts on the individual or firm, hence tax payments need to be included in the analysis. If the project generates tax liabilities, then the tax payable is relevant to the project, and must be accounted for as a cash outflow. Corporate tax is a cash outflow. If the tax were levied on net cash inflow and paid at the same time cash was received, then the after-tax net cash flow would be easily calculated. However, tax is not based on net cash flow, but on taxable income.

Taxable income is defined by the relevant tax act and does not necessarily mean the same thing as net cash flow or even accounting income or accounting profit. Taxable income is generally calculated by subtracting allowable deductions from assessable income. These terms are specific to particular tax acts, and are not easily dealt with in a general context. However, project evaluation needs to be able to accord some treatment to this calculation to determine after tax cash flows.

Treatment of depreciation

The tax definition of 'deductions' treats some non-cash items as allowable expenses. One such item frequently encountered in project analysis is asset depreciation. Depreciation is not a cash flow. It is an allocation of the initial cost of an asset over a number of accounting periods. Asset costs are allocated within accrual accounting systems so that they are matched over time against the income generated by the assets. That is, the initial cost of an asset is expected to benefit the firm over several years, hence the total initial cost is 'spread' over those future benefit years.

The actual per annum dollar amount of depreciation is only a notional amount. It does not represent the annual decline in value of the asset, it does not measure the value of the asset used up, and it does not measure the actual unit costs of the asset's services. A number of accounting methods can be used to calculate depreciation i.e. straight-line, reducing balance, 'sum of years digits' and units of production methods.

In project evaluation, what is relevant is not the accounting depreciation but the tax-allowable depreciation. The methods of calculating tax-allowable depreciation are often prescribed by the taxation legislation within a country. Sometimes the firm will have a choice between alternative prescribed methods, and in these cases the firm usually selects the method which will reduce the overall tax bill. The tax bill will be reduced if higher depreciation is claimed in the earlier years, thus delaying the payment of tax. The reducing balance method has this effect. Many national tax acts permit *accelerated depreciation* of equipment by allowing depreciation methods (defined in the tax act) which allow higher tax deductions in early years and lower deductions later. The Modified Accelerated Cost Recovery System (MACRS) in the USA. is an example.

It is important to understand that the interest in depreciation in financial analysis lies only in its tax effect, i.e. the depreciation tax shield or the reduction in taxes attributable to the depreciation allowance. If depreciation were not a tax deduction, it would not be considered in an NPV evaluation.

Treatment of financing flows

Treatment of financing flows is an area of confusion and sometimes a source of error in project analysis. It is important to distinguish between *project cash flows* and *financing cash flows*. For the purpose of identifying the relevant cash flows for project evaluation, the investment decision (project) must be separated from its financing decision. The financing investment decision involves deciding upon what proportion of the cash flows needed to fund the project are provided by debt holders and what proportion are provided by equity holders (i.e. from cash already held by the firm). The decision about the particular mixture of debt and equity used in financing the project is a management decision concerning the trade-off between financial risk and the cost of capital. The investment evaluation decision determines whether the project's discounted cash flows exceed the initial capital outlay (investment), and so adds (net present) value to the firm.

Generally, interest charges or any other financing costs such as dividends or loan repayments are not deducted in arriving at cash flows, because the interest is in the cash flow generated by the assets of the project. Interest is return to providers of debt capital. It is an expense against the income generated to equity holders, and as such is deducted in the determination of accounting profit. However, it is not included in project cash flow analysis, because the discount rate employed in the NPV calculation accommodates the required returns to both equity and debt providers. Therefore, inclusion of interest charges in cash flow calculations essentially would result in a double counting of the interest cost.

Interest is tax deductible, and therefore provides a tax shield for any investment. This benefit is also accounted for in the discount rate, as the rate employed in project analysis is an 'after-tax' rate. Accordingly, tax savings on interest expenses are not included in project cash flow analysis.

Almost always there are exceptions to general rules or practices and this is the case for the general rule for the treatment of financing flows. There are situations where interest charges are explicitly incorporated into the cash flows. The question here is not whether it is right or wrong to incorporate financing flows into the cash flow analysis, but whether that incorporation is done correctly or incorrectly. If it is necessary to show the financing flows explicitly in the cash flows, as is often preferred by non-financial mangers and chief executives, it is quite possible to include them explicitly in a correct and consistent manner without distorting the final results.

In property investment analysis, 'property' cash flows are distinguished from 'equity' cash flows. Property cash flows are the equivalent of 'project' cash flows discussed in this module. Property cash flow calculations do not include loan repayments and interest charges as deductions. This approach is consistent with the general cash flow definition in this module. 'Equity' cash flow calculations deduct loan repayments and interest expenses.

One of the objectives of property investment analysis is to evaluate the return to the investor under various debt and tax situations. A mortgage applies specifically to one particular property, rather than being an unidentified part of the capital structure of a corporation. Some investment in property is to gain tax advantages from interest deductions associated with debt financing. For these reasons, in property investment analysis, equity cash flows are calculated after deducting loan repayments (principal plus interest) from other cash inflows to enable the effects of borrowing and taxation to be evaluated.

Inflation and consistent treatment of cash flows and discount rates

Inflation will have an effect on the expected cash flows of the project. Both cash inflows and outflows could be affected by inflation. Market rates, such as interest rates and equity returns, in general will also rise when the expected inflation rate is high. As the market rate rises the required rate of return by investors will also rise. To deal with inflation appropriately, the project analysis must recognize expected inflation in the forecast of future cash flows and use a discount rate that reflects investors' expectations of future inflation.

If all cash flows as well as the discount rate are equally affected by expected inflation, the net present value is the same whether the inflation is include or excluded. However, most projects will consist of a multitude of cash flow items over a number of years and it would be erroneous to assume that all of the cash flows would increase at exactly the same rate each year, or to assume the same effect on the discount rate. Some cash flows are unaffected by inflation while other cash flows are affected to varying degrees by inflation.

An outstanding example of the differential impact of inflation on a project's cash flow is the depreciation tax shield. Tax-allowable depreciation is totally unaffected by inflation. Depreciation tax shields are calculated on the basis of historical costs of the assets (cost at the time of their acquisition). Similarly, a long-term raw-material contract or the purchase of a commodity in the *forward* or *futures* markets may lock in the present prices thereby insulating the cash flow from inflationary effects.

Given the differential impact of inflation on different cash flow components, cash flow forecasts in *nominal* terms – incorporating the inflationary effect – have an advantage over cash flow forecasts in *real* terms – excluding the inflationary effects. That is, nominal cash flow forecasts can incorporate potentially different inflationary trends in product price, labour and material costs, and so on, into cash flow estimates by applying different inflation rates for different components of the cash flow.

The required rate of return used for discounting cash flows is normally derived from observed market rates such as interest rates and return on equity. These observed market rates usually have the expected annual inflation rates built in and are usually quoted in *nominal* terms (as opposed to *real* terms).

Observed market rates expressed in nominal terms can, if necessary, be converted into their real terms using the algebraic relationship expressed in the Fisher effect. The Fisher equation is:

$$(1+n) = (1+r)(1+p) \qquad (1)$$

where, n = the annual nominal interest rate (expressed as a decimal value)
r = the annual real interest rate (expressed as a decimal value)
p = the expected annual inflation rate

From the above equation the real interest rate can be easily derived as

$$r = \frac{(1+n)}{(1+p)} - 1 \qquad (2)$$

Consistency in the discounted cash flow analysis requires that if the project's cash flows are in nominal terms then they should be discounted by nominal discount rates, and if the project's cash flows are in real terms they must be discounted by real discount rates. Real and nominal quantities cannot be mixed and matched.

The interest rate used for discounting cash flows is normally derived from observed market rates. In an efficient financial market, investors' required rate of return will include a component, (1+p), to compensate for expected inflation. The use of observed market-required rates then implies that inflation should incorporated into cash flows, to be consistent.

On rare occasions, real cash flows are appropriate in the analysis. In such situations, the real discount rate can be calculated from market (nominal) rates using the Fisher equation presented above.

4. THE DISCOUNT RATE

The discount rate used in an analysis greatly affects the NPV estimate. The choice of an appropriate discount rate thus becomes critical in the appraisal of any project. Differences in the focus of CBA and FA once again tend to mean different approaches are used in determining the appropriate discount rate. The focus on the individual or firm in financial analysis means that the discount rate is firm specific. In essence, it is the risk-adjusted rate that the firm or individual considers appropriate for the project being evaluated. Often this equates to the 'cost of capital' for the project. If a project were to be financed entirely by a loan, the cost of capital would be the rate at which the firm could borrow the money for the project. If this rate was say 9% per year, then this is the cost of capital and the appropriate discount rate would be 9%. This is a rather simplistic example and in real life things are much more complicated. As in CBA, a sensitivity analysis involving the application of a number of discount rates is usually undertaken, e.g. using the preferred rate plus or minus two percentage points.

What are the components of a discount rate?

In most standard financial analyses a risk adjusted discount rate (RADR) is used. Conceptually, the RADR has three components:

- *Risk free rate* to account for the time value of money (r).
- An *average risk premium* to compensate investors for the fact that the company's assets (or investments) are risky. This is a risk premium to account for the business risk of the firm's existing activities, being simply *the average risk premium for the firm*. This is denoted as 'u'.
- An *additional risk factor* (which could be zero, negative, or positive) to account for the difference in the risk between the firm's existing business

and the proposed project, which is denoted as 'a'.

Thus, conceptually, the RADR (which will be referred to as k) may be expressed in an algebraic form as:

$$k = r + u + \text{a}. \qquad (3)$$

If the risk of the proposed project is same as the average risk of the firm's existing projects, the additional risk factor 'a' is zero. The required rate of return (or the RADR) to be employed as the discount rate for *projects of average risk*, is then 'r+u'.

Estimating the RADR

In estimating the RADR to be used in project evaluation, in practice, the three different components may not always be calculated separately and added. For example, if cost of capital is used to estimate the RADR, then a value of '$r + u$' is obtained, to which can be added a value to account for 'a' (which could be negative). On the other hand, if capital asset pricing model (CAPM) is used to estimate the RADR, then separate values for r, u, and a will be obtained.

The risk-free discount rate, 'r' may be arrived at by examining government bond yields or insured banks' term deposit rates. By examining data published in the financial press, a suitable figure for 'r' can easily be arrived at. When doing so, it is important to that use a bond, guaranteed loan or other financial asset with a similar term to that of the project. For example, if a project stretched over 5 years, then the rate on a 5-year government bond or a 5-year insured fixed deposit would be adopted.

The Average Risk Premium for the Firm, 'u' may be estimated using the firm's cost of capital. The weighted average cost of capital (WACC) is normally adopted for calculating this. Another approach to estimate 'u' is to use capital asset pricing model (CAPM). Illustration and application of these involve relatively lengthy calculations.

The Additional Risk factor 'a' is the difference between the average risk faced by the firm and the perceived risk of the proposed project.

5. ANALYSING PROJECT RISK: SENSITIVITY AND BREAKEVEN ANALYSIS

There are numerous ways to analyse projects for risk. Two of the most widely used are sensitivity analysis and breakeven analysis.

Sensitivity analysis

One of these is to evaluate the project under various scenarios in which selected parameters or variables are stepped through their pessimistic, most likely and optimistic values. In this analysis, often only one parameters at a time is changed. The resulting set of NPVs reveal to management which variables have a material impact on financial performance of the project. Management can then decide to either invest more time and effort in establishing more reliable forecasts for these parameters, or to abandon the project because of excessive risk.

The steps in sensitivity analysis are:

1. Calculate the project's net present value using the most likely estimate for each parameters.
2. Select from the set of parameters those which management feels may have an important bearing on the project.
3. Forecast pessimistic, most likely and optimistic values for each of these parameters over the life of the project.
4. Recalculate the project's net present value for each of the three levels of each parameters. Whilst each particular parameters is stepped through each of its three values, all other parameters are held at their most likely values.
5. Calculate the change in net present value for the pessimistic to the optimistic range of each parameters.
6. Identify parameters for which project financial performance is sensitive.

Break-even analysis

Break-even analysis is a special application of sensitivity analysis, which endeavours to find the levels of individual parameters at which the project's NPV is zero. For example, management may wish to know how low can the unit selling price can fall before the project becomes unsuccessful. If managers know that this 'cut-off' price is likely to eventuate, then they may decide not to proceed with the project.

In common with sensitivity analysis, parameters selected for break-even analysis are typically tested only one at a time. Within an Excel spreadsheet, the calculations can be carried out in three ways:

1. by creating a data table for a range of values and reading off the appropriate value at a zero NPV.
2. by trial-and-error substitution of variable values within a spreadsheet
3. by using the Excel 'Tools – Goal Seek' function.

Management can use the break-even results in two ways. They may decide to abandon the project prior to implementation if forecasts show that near break-even parameter levels can be expected to occur. Once a project is implemented, management can react to a worst-case scenario involving the investigated parameters, e.g. suspend production, try to make production more efficient, or adjust the unit selling price.

6. DETAILED EXAMPLE OF A FINANCIAL ANALYSIS OF A FORESTRY PROJECT

A case study of a forestry investment is now presented to illustrate the steps of financial analysis. The example concerns a company (lets call it Flores Venture Capital Ltd, or FVC Ltd) which is considering diversifying its operations into forestry. The company has obtained a consultant's report on the proposal, which involves the establishment of a plantation estate of 1000 ha in an area with suitably high rainfall and soil quality. To encourage investment in the region, a local government has offered the required land rent-free for the period of the project on the condition that a native species rather than an exotic pine is grown. The company has decided to establish a mixed species (eucalypt and rainforest species) plantation. The finance department of FVC Ltd has indicated that a rate of return of 7% is required for the project.

Step 1: Identifying the forestry system

In Module 3, it was demonstrated how the Delphi method could be used to develop estimates of key parameters. The example used was for a forestry project involving the use of two species for which little quantitative growth and harvest age data existed. In this module, it is demonstrated how a forestry financial evaluation can be undertaken using similar data. The example in Module 3 was based on a real-life Delphi survey and the associated financial analysis was highly complicated; the basic information from that example will be used here, but will be simplified in a number of ways.

Because there was no past experience in growing native species in the region, the consultant used the Delphi method to develop an appropriate silviculture (tree growing) system. Based on the results of this investigation, it is recommended that trees be planted at a density of 660 stems per hectare. It is expected that extensive weed control will need to be undertaken in the first year, with further weed control required in the second and third year. Pruning of the trees to ensure good form will be required in years 2, 4 and 6. A number of experts involved in the Delphi survey indicated that the amount of pruning required is difficult to estimate because no one knows how much branching will occur on the sites and this could range from minimal to requiring high labour inputs. The consultant has explained that pruning is crucial because it ensures that the trees produce a straight, knot-free log for which high prices can be obtained. It was also recommended that each pruning event should be certificated by an external party because this will increase the likelihood of being able to obtain a premium price for knot-free wood. A non-commercial thin is required at year 8, at which time 320 trees will be removed.

The first revenue from the plantation is predicted to come when a commercial thinning occurs at the end of year 17, at which time about 85 trees will be harvested. At year 26, 85 further trees will be cut and sold for telephone and electricity poles. The best 85 trees will be left to grow until year 34, when about half (42) will be cut for sawlogs. The remaining trees will be allowed to grow to year 60 when they will be harvested and sold as high quality veneer logs.

From the above information about the plantation system, the major cash outflow and inflow categories have been identified as listed in Table 1.

Table 1. Main cash categories and predicted timing

Cashflow category	Nature of cashflow	Timing (year)
Establishment (capital) costs	Planning and design	0
	Incidental clearing	0
	Site preparation and cultivation	0
	Cover crop establishment	0
	Pre-plant weed control	0
	Cost of plants	0
	Planting and refilling	0
	Post plant weed control	0
	Fertilizer	0
	Fencing	0
Maintenance costs	Post plant weed control (1)	1
	Post plant weed control (2)	2
	Post plant weed control (3)	3
	First prune(plus certification)	2
	Second prune (plus certification)	4
	Third prune (plus certification)	6
	Thinning – non commercial	8
Annual costs	Protection and management	
	Land rental (if applicable)	
Cash Inflows	Thinning revenue	18
	Revenue from poles	26
	Revenue from 1st harvest	34
	Revenue from 2nd harvest	60

Step 2: Estimating cash outflows

Estimates are now made of the likely quantum of the cash outflows associated with the categories of Table 1. This has drawn on information from a number of sources, e.g. quotes sought for the cost of establishing the plantation and for pruning costs based on past experience. Table 2 provides the financial estimates of each of these activities provided by the consultant. For convenience, all estimates are expressed on a per hectare basis.

Table 2. Cash outflows and timing associated with a two-species plantation

Cost group	Nature of cash outflow	Timing (yr)	Cost ($/ha)
Establishment costs	Planning and design	0	74
	Incidental clearing	0	158
	Site preparation and cultivation	0	265
	Cover crop establishment	0	88
	Pre-plant weed control	0	92
	Cost of plants	0	450
	Planting and refilling	0	645
	Post plant weed control	0	540
	Fertilizer	0	83
	Fencing	0	560
	Sub-total		2955
Maintenance costs	Post plant weed control (1)	1	1300
	Post plant weed control (2)	2	800
	Post plant weed control (3)	3	200
	First prune(plus certification)	2	800
	Second prune (plus certification)	4	800
	Third prune (plus certification)	6	800
	Thinning – non-commercial	8	500
Annual costs	Protection and management		40
	Land rental		0

Step 3: Estimating cash inflows

Cash inflows arise from the harvest of the trees. Harvest revenue is determined by the volume of timber (in m^3) produced multiplied by the stumpage price paid ($/$m^3$). For example, if a commercial thinning occurs at year 17 (as in the current example) and yields 170 m^3 of timber with an estimated sale (stumpage) price of $30/$m^3$, this will result in estimated cash inflows of $5100/ha.

Estimates of cash inflows are particularly difficult to make for forestry investments. The long production cycle means that it is difficult to estimate what stumpage prices will be many years into the future. In rare cases, long-term supply contracts may be signed with a guaranteed sale price. Even in these circumstances the uncertainty associated with harvest volumes means there remains considerable uncertainty when estimating cash inflows from harvests. Some revenues may be obtained from commercial thinnings part way through the production cycle, though stumpage price is usually low due to small diameter trees and low timber quality. Typically there is no market for thinnings of a very young age, in which case the thinning process results in a net cash outflow. This is the case in year 8 of the current example where a non-commercial thin is required costing an estimated $500.

The largest cash inflows from plantations will come at the end of the production cycle. In the current example, final harvest revenue takes place after 60 years, although another significant harvest occurs at 34 years. For this case study, estimates of harvest volumes and timing were collected as part of the Delphi survey undertaken by the consultants. These estimates, combined with estimates of future timber prices (in nominal dollars and also collected as part of the survey) can be used to estimate cash inflows (Table 3). The expert panel used in the Delphi survey thought high quality sawlogs of a native hardwood produced at year 34 should achieve a price of $200/$m^3$. Furthermore, it was thought that it was likely that logs harvested at 60 years would be suitable for the production of veneer, and attract a premium of 50% above the price of high quality sawlogs.

Table 3. Estimated cash inflows for 1000 ha plantation

Activity resulting in cash inflow	Year of harvest	No. stems/ha	Yield (m^3/ha)	Stumpage (\$/m^3)	Revenue (\$1000)
First thinning	17	170	170	$30	$5,100
Second thinning (poles)	26	85	--	$148 per pole	$12,580
First harvest (sawlogs)	34	42	100	$200	$20,000
Second harvest (sawlogs/veneer logs)	60	43	270	$300	$81,000

Step 4: Developing the financial model

For simplicity, the tax component of the analysis has been simplified. It is assumed that all cash outflows are fully allowable as deductions in the year that they are paid. In most years there is no revenue from the plantation against which to offset these tax losses. It is however assumed these losses can be claimed against income generated from other company operations, producing a tax benefit equivalent to the amount of the net cash outflows multiplied by the prevailing tax rate (30%).

A number of other assumptions have been made in the analysis that are worth mentioning. A nominal rate of interest of 7% has been used which includes a risk premium of 3%. Prices of all cash-flow items are assumed to increase over time at a rate equal to the underlying inflation rate, so that no adjustment of either cash inflows or outflows are needed.

The computer spreadsheet package Excel provides a convenient platform for financial analysis, to calculate key financial parameters such as NPV and IRR. Such a spreadsheet is presented as Table 4.

Step 5: Undertake a sensitivity analysis

Once the financial model has been set up, it is a simple task to examine at the effect of changes in parameter levels on the project performance criteria. This includes analysis with respect to required rate of return and with respect to parameters which are not under the control of the company.

The Excel Table function has been used to derive NPV values for a range of discount rates, and these have been plotted in Figure 2. Note that the IRR is the discount rate for which NPV is zero, i.e. the point where the curve in Figure 2 crosses the x-axis. This analysis suggests that the project is marginal in terms of financial acceptability. At the real rate of return of 7% required by management, the NPV for the project is -$58,214, and the IRR is just below 7% (6.96%). Figure 2 also presents the *land expectation value* (LEV) or *site value* for the project. This is the NPV for an infinite sequence of identical rotations, and is useful to compare forestry projects of unequal duration. The LEV will be considerably higher than the NPV for short rotations, but for long rotations (such as in the case study project) LEV will differ little from NPV.

Parameters outside the control of the company which are likely to have most effect on NPV have been identified, and pessimistic, most likely and optimistic levels identified for each, as in Table 5.

The spreadsheet used in the calculation of NPV and IRR for the most likely values in Step 4 has been used to recalculate these values for the optimistic and pessimistic values for each of the parameters of Table 6. Only one variable is changed at a time, while all the other variables are held at their most likely values. The 'Scenario' function in Excel allows multiple scenarios to be developed and the results reported in a table in a separate spreadsheet. This function has been used to undertake the sensitivity analysis, results of which are reported in Table 6.

Table 4. NPV calculations for forestry investment, with 7% discount rate ($1000s)

Annual protection and management		-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40

CASH FLOW ITEM	Timing of cash flow (end of year)																
	0	1	2	3	4	5	6	7	8	9-16	17	18-25	26	27-33	34	35-59	60
ESTABLISHMENT COSTS (Capital Costs)	-2955																
OPERATING COSTS																	
Post plant weed control		-1300	-800	-200													
First prune(plus certification)			-600														
Second prune (plus certification)					-600												
Third prune (plus certification)							-600										
Thinning (non-commercial)									-500								
Land rental (capitalised @ 4% of $2000/ha)																	
TOTAL OPERATING EXPENSES		-1340	-1440	-240	-640	-40	-640	-40	-540	-40	-40	-40	-40	-40	-40	-40	-40
OPERATING REVENUE																	
Thinning revenue 1 (year 17)											5100						
Thinning revenue 2 (year 26)													12580				
Harvest Revenue 1 (year 34)															20000		
Harvest Revenue 2 (year 60)																	81000
Total OPERATING REVENUE	0	0	0	0	0	0	0	0	0	0	5100	0	12580	0	20000	0	81000
TAX PAID OR TAX BENEFIT (30%)	886.5	402	432	72	192	12	192	12	162	12	-1518	12	-3762	12	-5988	12	-24288
NET CASHFLOWS (Operating revenue - capital outlays - operating costs)	-2068.5	-938	-1008	-168	-448	-28	-448	-28	-378	-28	3452	-28	8778	-28	13972	-28	56672
NET PRESENT VALUE OF CASH OUTFLOWS AT DISCOUNT RATE SPECIFIED	-58.214																
INTERNAL RATE OF RETURN	6.96%																

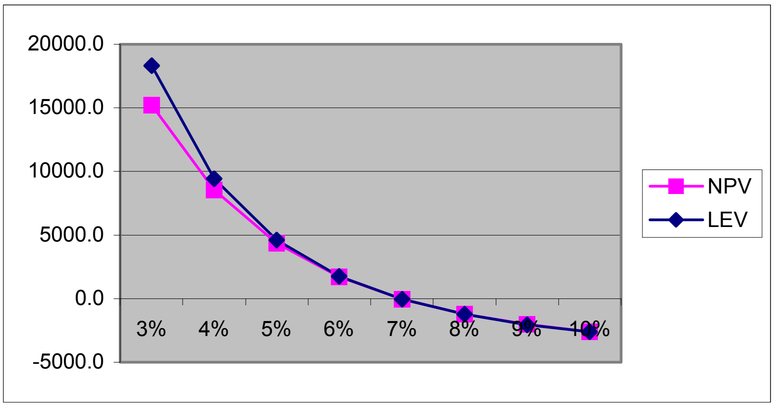

Figure 2. NPV Profile of FVC Ltd. forestry investment ($1000)

Table 5. Parameters selected for sensitivity analysis

Uncontrollable variable	Pessimistic ($1000)	Most likely ($1000)	Optimistic ($1000)
Stumpage price, first thinning ($/m^3)	25	30	35
Stumpage price, poles ($/pole)	110	148	200
Stumpage price, first harvest ($/m^3)	100	200	300
Stumpage price, second harvest ($/m^3)	150	300	450
Yield, first thinning (m^3)	120	170	190
Yield, poles (number)	70	85	85
Yield, first harvest) (m^3)	80	100	150
Yield, second harvest (m^3)	220	270	350
Establishment costs ($)	3455	2955	2655
Post plant weed control, year 1 ($)	1800	1300	1000
Post plant weed control, year ($)	1100	800	600
Post plant weed control, year 3 ($)	400	200	0
Pruning, years 2, 4, 6 ($)	1000	600	500
Thinning costs, year 8 ($)	800	500	400

Table 6. NPVs for forestry investment for pessimistic and optimistic parameter levels ($1000)

Parameter	Pessimistic estimate	Optimistic estimate	Range	Rank
Stumpage price, first thinning ($/m^3)	-247	130	377	10
Stumpage price, poles ($/pole)	-448	475	922	4
Stumpage price, first harvest ($/m^3)	-760	643	1403	1
Stumpage price, second harvest ($/m^3)	-547	431	978	3
Yield, first thinning (m^3)	-391	75	465	9
Yield, poles (number)	-326	-58	268	12
Yield, first harvest) (m^3)	-339	643	982	2
Yield, second harvest (m^3)	-239	232	471	8
Establishment costs ($)	-408	152	560	6
Post plant weed control, year 1 ($)	-385	138	523	7
Post plant weed control, year ($)	-242	64	306	11
Post plant weed control, year 3 ($)	-172	56	229	13
Pruning, years 2, 4, 6 ($)	-703	103	806	5
Thinning costs, year 8 ($)	-180	-17	163	14

The results of the sensitivity analysis could be now used by the company as a guide to which parameters need to be investigated further. From the sensitivity analysis it is clear that the stumpage prices for the first and second harvests and for poles, along with the yield for the first harvest, are the parameters that have the greatest effect on project NPV. The company may investigate ways to reduce the impact of uncertainty with respect to these parameters, such as through investing further resources into developing more accurate yield predictions or investigating further projections of future timber prices. It may also use the existing data to undertake an investigation of the three most critical parameters at a greater number of values within the range from pessimistic to optimistic.

7. CONCLUDING COMMENTS

This module has shown that the approach required for financial analysis differs somewhat from that of cost-benefit analysis. Key differences arise in treatment of social and environmental externalities and transfer payments such as taxation. In corporate project evaluation, often real discount rates are used, with allowance for differing inflation rates with respect to cost and revenue items. The discount rate may also differ from that employed in CBA.

The case study illustrates a stepwise application of a spreadsheet package to perform financial analysis including determining performance criteria such as NPV and IRR and carrying out sensitivity analysis is relatively straightforward, providing reliable cost and revenue data can be obtained for a forestry project.